

# STUDIES IN NEW WORLD AMARANTHUS (AMARANTHACEAE)

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## ABSTRACT

*Amaranthus crassipes* is recognized as consisting of two varieties: var. *crassipes* from the West Indies, coastal Mexico-Texas-Louisiana, and northern South America, and var. *warnockii* of the Chihuahuan Desert region of Texas and Mexico. *Amaranthus scleropoides* contains two morphs that are not taxonomically recognized. *Amaranthus*  $\times$  *texensis*, considered of hybrid origin between *A. crassipes* and *A. scleropoides*, is described as new. *Amaranthus berlandieri* is not considered as distinct from the more wide ranging *A. polygonoides*. A new species, *Amaranthus tamaulipensis*, is described from southmost Texas and eastern Mexico. It is related to *A. dubius* and the poorly known *A. brandegei* of Sinaloa. An enigmatic *Amaranthus*  $\times$  *tucsonensis* is described from the Tucson Mountains of southern Arizona, with related populations occurring in Sonora, Mexico.

## RESUMEN

Se reconoce a *Amaranthus crassipes* como constituida por dos variedades: la var. *crassipes*, con distribución desde la costa de México, Texas y Louisiana, a través del Caribe hasta el norte de Sudamérica; y la var. *warnockii*, de la región del Desierto Chihuahuense. *Amaranthus scleropoides* consiste de dos fases morfológicas sin designación de rango taxonómico formal. La noroespecie nueva *Amaranthus*  $\times$  *texensis* probablemente se originó de la hibridación entre *A. crassipes* y *A. scleropoides*. No se considera a *A. berlandieri* como diferente de *A. polygonoides*, especie de más amplia distribución. Se describe *Amaranthus tamaulipensis*, especie nueva del este de México y la parte más meridional de Texas. Esta especie está relacionada con *A. dubius* y con *A. brandegei*, taxon sinaloense pobremente conocido. Se describe la enigmática *Amaranthus*  $\times$  *tucsonensis* como noroespecie nueva de la Sierra de Tucson, del sur de Arizona.

KEY WORDS: *Amaranthus*, *Amaranthaceae*, plant taxonomy, plant systematics, hybridization.

Studies in the *Amaranthaceae* in connection with the Chihuahuan Desert Flora have resulted in this paper on the systematics of the *Amaranthus crassipes*-*A. scleropoides* and *A. polygonoides* groups. Two additional taxa are described as new.

The *Amaranthus crassipes*-*A. scleropoides* group has dichasial clusters of flowers borne at all nodes from the base of the plant to the tip. The inflorescences are modified compound dichasia in which the terminal flowers are overtopped by opposite, sinuous peduncles that bear one to a few pairs of persistent bracts with mostly male flowers and terminate in pistillate flowers that are again overtopped by similar paired, sinuous peduncles. As the peduncles

mature they become greatly thickened and indurated in some species and trap the fruit between the expanded peduncles (Fig. 3A, D). Gray (1862) considered thickened peduncles to be an abnormal character in *A. crassipes*, but Holzinger (1892) showed they were consistently produced in that species, caused by a proliferation of expanded parenchyma cells that develop thickened walls. At maturity, the entire inflorescence falls from the plant and serves as a dispersal unit capable of flotation.

#### VARIATION WITHIN *AMARANTHUS CRASSIPES*

*Amaranthus crassipes* Schlttdl. is a widespread New World species occurring from the West Indies, Bahamas, Florida Keys, Arizona, Texas, Mexico, Colombia, and Venezuela (Fig. 1)—its type locality is on St. Thomas in the Virgin Islands. The species consists of decumbent-procumbent, glabrous, monoecious annuals with ovate-obovate to lanceolate, long-petiolate leaves. The flowers are produced at each node usually from the base of the plant upwards in short dichasia 5–10 mm long (Fig. 2C, E). The dichasia develop the aforementioned greatly thickened, indurate, strongly sinuous lateral axes (Fig. 3A). The female flowers have 5 erect to spreading, narrowly spatulate sepals that are thickened and joined at the base (Fig. 3B). They are usually shorter than the fruit. The fruit wall is closely adherent to the seed and indehiscent, although it may develop a colored encircling line below the middle. It is usually smooth below and somewhat tuberculate above and along the margins. The 2(–3) styles are joined together into a distinctive lyrate-shaped neck before they taper and diverge as slender tips (Fig. 2A–C). The male flowers are produced on the sides of the developing inflorescence axes. They mature and fall away before the inflorescence axes thicken and they have 5 membranous sepals and three anthers.

Throughout the Caribbean region the plants are initially erect but usually become procumbent weeds in disturbed places. They usually have ovate, broadly ovate to obovate leaves that may either be uniformly small or, in fast growing plants, large in size. (Fig 2C). Similar ovate-leaved plants also occur in northern South America, the Yucatan Peninsula, northeast Mexico, coastal Texas, Louisiana, Key West (Florida) as well as Sonora and Arizona. In contrast, plants in inland Texas and in the Chihuahuan Desert region, develop narrower, more oblanceolate, grayish leaves (Fig. 2E). They also tend to be more erect or decumbent in growth habit, features that are shared with the related *A. scleropoides*. The grayish color of the leaves also make the reticulate pattern of the Kranz structure less conspicuous. In 1944 I.M. Johnston described these inland plants as *Amaranthus warnockii*, distinguishing the species by its elongate, somewhat thinner oblanceolate leaves, its less elongate, more slender stems, and smaller more compact cymes conspicuously crowded at the stem bases. Except for the narrower, more oblanceolate-lan-

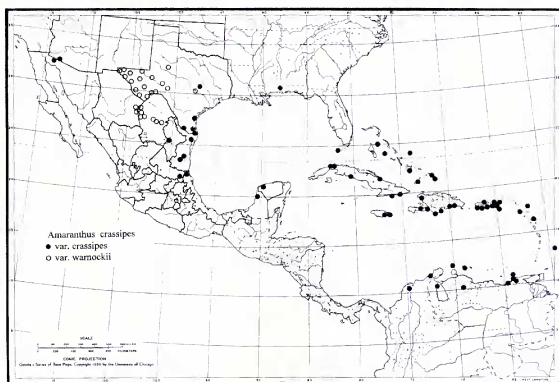


FIG. 1. Distribution of *Amaranthus crassipes* var. *crassipes* and var. *warnockii*.

ceolate leaves, all the other features noted by Johnston also occur in occasional plants of *A. crassipes* throughout its range. In all technical characters of flowers, fruit and inflorescence, *A. warnockii* and *A. crassipes* are identical.

Recognition of these two taxa at the species level is considered unjustified as the distinguishing features are minor and to some extent inconsistent and recognition would create poorly differentiated microspecies within this highly variable genus. But overall the group of specimens referable to *A. warnockii* can be recognized solely on the basis of the narrower, more oblanceolate, grayish leaves. Because of this *A. warnockii* is here retained at the varietal level as it represents a geographically based subunit of the species (Fig. 1). Correll and Johnston (1970), in contrast, considered *A. warnockii* synonymous with *A. crassipes*. The collections from southern Arizona and adjacent Sonora, however, have distinctly ovate leaves and fall within var. *crassipes*. A formal description of *A. crassipes* follows.

#### AMARANTHUS CRASSIPES

Low spreading, taprooted, procumbent to decumbent, basally branched, monoecious annuals, sometimes with the central stems erect-ascending; stems glabrous, striate, stramineous, moderately branched, 1–4(–9) dm long; internodes 1.5–4 cm long below, reduced to 5–15 mm long distally. Leaves alternate, ascending, (12–)30–55(–78) mm long, the petioles slender, (5–)10–25(–47) mm long; leaf blades broadly to narrowly obovate to ovate, to

oblanceolate or elliptical, (7–)20–30(–50) mm long, (5–)10–20(–28) mm wide, obtuse to rounded, usually retuse with the midvein short-excurrent at the tip, narrowly acuminate-cuneate at the base, the margins entire to erose-cripsed, whitish, the veins curved towards the tip, but not extending to the margins, distinctly whitened beneath, the lamina glabrous, with distinct Kranz internal anatomy. Flowers borne in axillary, congested, tan or rarely dark brown, glomerate dichasia 5–9 mm long usually borne at all nodes from the base of the plant upwards, the dichasia decussately branching below each pistillate flower, the branches strongly sinuate-curved, becoming thickened and indurated, 0.9–1.2(–1.6) mm thick and crowding-enclosing the developing fruit; bracts and bracteoles broadly deltate, 0.5–0.9 mm long, green along the midrib, the margins scarious, broadly attached at the base, persisting on the sides of the thickened dichasia. Staminate flowers produced on the sides of the developing dichasia, with 5, subequal, lanceolate sepals 1.2–1.6 mm long, these membranous except where green along the midrib, acute; stamens 3; anthers 0.7–0.9 mm long; filaments 1.5–2 mm long. Pistillate flowers born at each branch of the dichasium; fruiting sepals 5, with 2 at each margin of the fruit and with a smaller sepal on one face, 2 on the other face, the sepals distinctly clawed or merely spatulate, 1.4–2.3 mm long, the claws narrowly linear, 0.1–0.2 mm wide, keeled, expanding to ovate, acute, slightly keeled, conduplicate, sometimes slightly reflexed tips 0.5–1 mm long and nearly as wide, the tips each with a green in a trullate patch medially and with membranous margins, the sepals expanding to become spongy-indurate, tan, united and truncated around the fruit base. Fruiting ovary compressed orbicular-obovate, 1.3–1.5 mm wide and long (excluding the style), the fruit wall somewhat thickened, closely surrounding the seed, indehiscent or in some plants with a darkened line in the lower half, usually but not consistently smooth below, distinctly tuberculate above and along the margins, topped with the persistent style; the styles 2(–3), about 1.5 mm long, connate and erect for 0.2–0.5 mm below, the yellowish lobes erect or usually lyrate, curving outward, then inward as they taper, terminating as slender outwardly curved appendages, the papillate-stigmas extending all along the inner surface of the styles onto the terminal slender portions. Seeds compressed-obovoid, 1.1–1.3 mm long, 0.9–1.1 mm wide, 0.6–0.7 mm thick, shiny, dark brown-black, the margin obtuse to somewhat rounded, the surface shiny, with a visible cellular surface pattern. With two varieties:

**Amaranthus crassipes** Schtdl. var. **crassipes** (Figs. 2A–C, 2A–B). *Linnaea* 6:757. 1831 (as *Amarantus*). *Scleropus crassipes* (Schtdl.) Moq. in DC. Prod. 13<sup>2</sup>:271. 1849; *Euxolus crassipes* (Schtdl.) Hieron., Bol. Acad. Nac. Córdoba 4:13. 1881. TYPE: WEST INDIES. St. Thomas Island. (Ad rivulos insulae St. Thomae, 1826–1828)



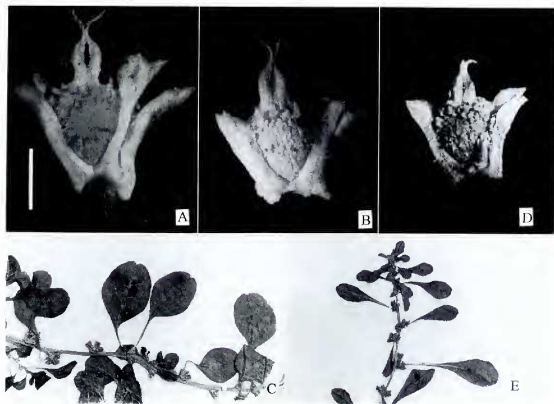


FIG. 2. Fruits and foliage of *Amaranthus crassipes*. A–C. *A. crassipes* var. *crassipes*. A. Mature fruit: note characteristic lyrate styles and clawed sepals that are united at the base (Cameron Co., Tex., Runyon 658, TEX). B. Mature fruit (Antigua, Box 573, NY). C. Characteristic ovate leaf blades (Apalachicola, Fla., Chapman Herb. 3383, NY). D–E. *A. crassipes* var. *warnockii*. D. Mature fruit (Presidio Co. Tex., Hinckley 129, SRSC). E. Characteristic oblanceolate leaf blades (Terrell Co., Tex. Warnock & Johnston 17209, SRSC). White bar in A = 1 mm for A, B, D, = 2 cm for C, E.

*Ehrenberg s.n.* (HOLOTYPE: HAL). Dr. U. Braun has sent a xerox copy of the holotype from HAL, deposited TEX.

*Scleropus amarantboides* Schrad., Index sem. Hort. gott. 1835; (reprinted in: *Linnaea* 11: Litt.-ber. 89. 1837). TYPE: unknown.

Plants typically erect when young but becoming procumbent, occasionally decumbent, leaf blades ovate to broadly ovate, sometimes nearly orbicular or obovate, (7–)15–30(–50) mm long, (5–)10–15(–28) mm wide, the lower surface green to yellow-green, distinctly marked by the whitish, arcuate veins.

Weed in roadsides, waste grounds, fields, pastures, in clay, silty, sometimes sandy flats, beaches, and rocky slopes in shaded or open habitats, widespread in the Caribbean region, south Florida, coastal Louisiana, Alabama (adventive), Texas, northeastern Mexico south to northern South America (Columbia, Peru), from sea level to 250(–1250) m (Fig. 1). It also occurs in Arizona, Sonora, Chihuahua at higher elevations. Collected throughout the year but

expected to be vegetatively active during hot months due to C<sub>4</sub> photosynthetic pathway.

**Amaranthus crassipes** Schltdl. var. **warnockii** (I.M. Johnston) Henrickson, comb. nov. (Fig. 2D-E). Basionym: *Amaranthus warnockii* I.M. Johnston, J. Arnold Arbor. 25:153. 1944. TYPE: MEXICO. COAHUILA: a mi SE of Ocampo, low place near mogote on plain, 8 Sep 1941, I.M. Johnston 8886 (HOLOTYPE: GH!).

Plants initially erect when young, the lateral branches becoming decumbent, ascending terminally; *leaf blades oblanceolate to narrowly oblanceolate*, (12–)16–33(–44) mm long, (4–)6–10(–16) mm wide, the *surfaces more glaucous-green*, the veins of the lower surface slender, not conspicuous.

Open silty flats, mesquite thickets, muddy areas to 1300 m elevation, in south-west Texas and in the Chihuahuan Desert in Coahuila and eastern Chihuahua (Fig. 1).

#### AMARANTHUS SCLEROPOIDES

In 1895 Uline and Bray described a second species related to *A. crassipes* differing in its circumscissile, smooth utricle and 3 style branches. Uline and Bray considered *Amaranthus scleropoïdes* intermediate between *A. crassipes* and *A. graecizans* *auth. non* L. (now *A. albus* L.), the latter also having 3 styles and circumscissile utricles. Vegetatively and in inflorescence structure, *A. scleropoïdes* is very similar to *A. crassipes*, but *A. scleropoïdes* is a taller, bushier plant. While its mature utricles are uniformly circumscissile, the pistillate flowers are somewhat variable in sepal structure, style number and other features. Mature sepals vary from 1.2–2.5 mm in total length. As in *A. crassipes*, two sepals are usually distributed at each edge of the mature fruit, with a two on one face and a one smaller sepal on the other face. The sepals are clawed and vary greatly in development. In some specimens the blade portion is erect, green, rounded, apiculate and rather flattened, however, in others, including the type collection, the tips are distinctly thickened, keeled, conduplicate, recurved, and sharp pointed, with a central green rhomboid patch (Fig. 4C). Styles vary from two to three (Fig. 4A–B), or rarely five (1-flower on *Cory* 2933 GH), with some plants being consistently two styled and others with varying numbers. In flowers with two styles, the styles are located directly over the margins of the compressed ovary and as the fruit mature the styles develop distinct decurrent ridges that extend down the fruit margins. When styles are three, the third, often reduced style, develops on one of the faces, again with a distinct decurrent base. The surfaces of the utricle may be smooth or tightly tuberculed.

Among collections observed, two distinct forms are recognizable based on differences in the development of the styles and upper ovary wall. The most common form has distinctly spongy-thickened style bases and the upper

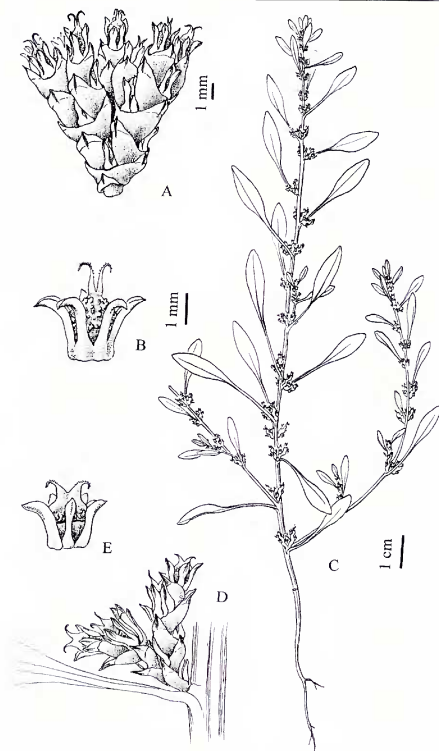


FIG. 3. *Amaranthus crassipes* and *A. scleropoides*. A-B. *A. crassipes* var. *crassipes*. A. Mature dichasial inflorescences have spongy-thickened, indurated lateral branches; the external bracts subtended male flowers, the female flowers are located at the base and tips of the inflorescence branches (Jamaica, Proctor 23937, NY). B. Mature fruit-calyx (Jamaica, Proctor 23937, NY). C-E. *A. scleropoides*. C. Young plant with characteristic narrow leaf blades, axillary inflorescences. D. Mature inflorescence. E. Mature fruit and calyx (all Williams Co., Tex., Walcott 303, TEX). Magnifications in A & B hold for D & E.

utricle is indurated and stramineous in color (Fig. 4A–B). The styles are papillate (stigmatic) along their inner margins and the papillae continue onto the slender terminal lobes. A second form does not develop expanded, indurated thickenings on the style bases and upper fruit and the two or three styles are thus clustered at the top of the fruit (Fig. 4C). The two forms both occur throughout the range of the species—they do not sort out geographically (Fig. 5). Because of this, and because this variation does not correlate with any other morphological or ecological variation, they are here recognized as unnamed forms. A description of the species follows.

**Amaranthus scleropoides** Uline & Bray, Bot. Gaz 19:316. 1894. (Figs. 3C–E, 4A–C, 5). TYPE: U.S.A. TEXAS: "Texas, Western Texas to El Paso," *Wright* 582; (LECTOTYPE: GH!; ISOLECTOTYPE GH!). Notation on lectotype by I.M. Johnston: "Texas: Val Verde County, *Wright* field number 798, Amaranth, Devil's River, summit of hills, 2 Aug 1849." The type has sepals with conduplicate, sharply divergent tips; the style base is not inflated as in some collections.

Very similar to *Amaranthus crassipes* vegetatively and in inflorescence and flower organization, but typically more erect, bushy, 2–5 dm tall and often as wide, with the lower stems ascending or decumbent and ascending to erect distally. Leaves with slender petioles (4–)10–25(–47) mm long; leaf blades lanceolate, oblanceolate to narrowly trullate, (5–)15–25(–42) mm long, (2) 5–10(–12) mm wide, glabrous, somewhat glaucous. Flowers borne in thickened, sinuate dichasia produced from the base to the top of the plant; staminate flowers with 5 sepals, 3 stamens. Pistillate fruiting sepals 5, with 2 at each margin of the fruit, two sepals on the one face, with one smallest sepal on the other face, the sepals moderately clawed to narrowly spatulate, in fruit (1.2–)1.5–2.2(–2.5) mm long, the claws 0.2–0.7 mm wide, the distal sepal blade typically broader, erect or variously reflexed,  $\pm$  keeled and conduplicate,  $\pm$  ovate-lanceolate, acute, with a small or large, central, green narrow to trullate green patch to 0.5–1 mm long, the margins membranous, the sepals expanding and becoming spongy-indurate, tan, and united around the fruit base. Fruiting ovary compressed orbicular-obovate, 1.1–1.3 mm wide and long (excluding the styles), the wall circumscissily dehiscent, with a distinct brownish medial line, the body smooth or becoming closely tuberculate above and less strongly tuberculate below the line of dehiscence, the styles 2–3(–5) [the third (fifth) one(s) smaller when present], arching outward from the upper margins of the fruit wall, the style bases continuing as decurrent ridges down the fruit wall, the lower portion of the styles and adjacent distal fruit wall (but not extending down to the line of dehiscence) often spongy-thickened, inflated, or the distal fruit wall and adjacent style bases only slightly inflated and ascending; the stigmas papillate, extending along the inner margin of the style lobes and continuing as slender tips for 0.4–0.5 mm. Seeds compressed obovoid, 1.0–1.1 mm long, 0.85–0.96 mm wide, 0.6–0.7 mm thick, dark

brown-black, the margin obtuse to somewhat rounded, the surface shinny, with a slightly visible cellular surface pattern.

A NEW TAXON FROM SOUTHERN TEXAS

Within the complex of *A. crassipes* and *A. scleropoides*, a series of specimens from southern Texas are characterized by an erect-ascending growth habit and what appear to be circumscissile utricles as in *A. scleropoides*. However, the utricles are thick walled, weakly and closely tuberculate and are actually indehiscent as in *A. crassipes* although a distinct medial line is present. As in *A. crassipes*, the styles are united at the base into a distinct neck before they separate, but the 2–3 styles have distinct decurrent ridges that extend down the utricule wall as in *A. scleropoides* (Fig. 4E). These specimens also have rather narrowly lanceolate to linear-lanceolate, long petioled leaves, and they tend to have longer, more strongly reflexed pistillate sepals of a type sometimes found in *A. scleropoides*. The specimens, some of which are sterile and produce no mature seed, appear to represent hybrids or derivatives of hybridization, perhaps between *A. crassipes* and *A. scleropoides*. These collections are all from loose red sands to sandy loams in southern Texas in Duval, Webb, Hidalgo, and Atascosa counties of southern Texas, with one collection from adjacent Tamaulipas. They are of sufficient distinction to be recognized as a separate nothospecies.

***Amaranthus* × *texensis*** Henrickson, nothosp. nov. (Figs. 4D, 5). TYPE: U.S.A. TEXAS. WEBB Co.: in red sand at roadside on Hwy. 83, 13 mi NW of Webb, 16 Jul 1957, D.S. Correll & I.M. Johnston 18101 (HOLOTYPE: LL!; ISOTYPE: GH!).

*A. Amarantho scleropoides* caulibus erecto-ascendentibus stylis (2–)3 et fructibus dehiscentibus semilis sed differt basibus styliaribus collum distinctum 0.2–0.4 mm longum formantibus (ut *A. crassipe*) et sepalis florum pistillatorum valde reflexis ad apices.

Annual herbs 10–35 cm tall; stems erect-ascending to decumbent, with scattered obscurely gland-tipped hairs to 0.3 mm long, glabrate. Leaf blades linear-ob lanceolate, (5–)13–25(–40) mm long, 2–6(–8) mm wide, obtuse-emarginate with the midvein excurrent at the tip, narrowly cuneate, the margins extending well down the (3–)5–15(–20) mm long petiole, the margins whitish, crisped, the blades green to gray-green with the veins impressed above, stramineous and raised beneath. Flowers borne in short, thickened, axillary dichasial cymes produced at each node of the plant from base to tip, the cymes 3.5–6 mm long, the cyme axes sinuate, stramineous, spongy-thickened, indurate, 0.5–1 mm thick, bracteate, the bracts 1–1.5 mm long, green medially in a diamond pattern with broad clasping scarious bases, the staminate flowers early deciduous, the dichasial cymes bifurcating at the bases of each pistillate flower and terminating in pistillate flowers; staminate flowers: sepals 5, narrowly ovate, 1.5–1.8 mm long, membranous except along the excurrent midvein; stamens 3; mature pistillate flowers: sepals 5,

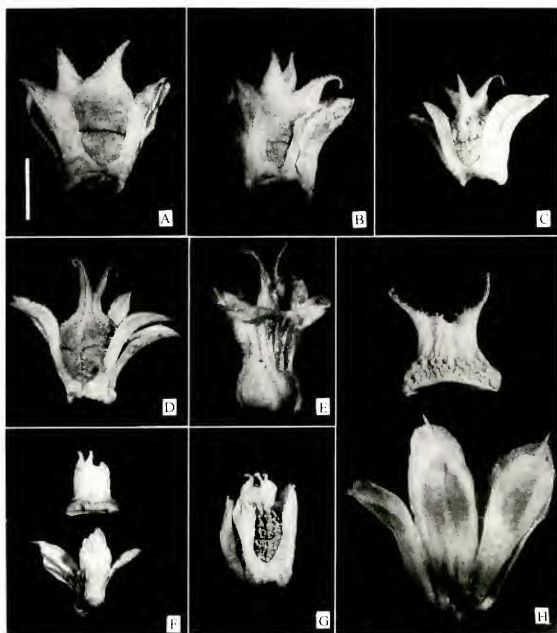


FIG. 4. Photographs of mature fruit and calyces. A–C. *Amaranthus scleropoides*. A–B. Fruit with inflated style bases, 2 or 3 styles (Cameron Co., Tex., Runyon 2397, F). C. Fruit with non-inflated style base, note recurved sepals (McLennon Co., Tex., York 46249, F). D. *A. × texensis*. Mature fruit, note narrow style base, sharply recurved sepals (Webb Co., Tex., Correll & Johnston 18101, LL-type). E. *A. polygonoides*. Mature fruit-sepals, note sepals have 3 veins and are inflated and indurated at base (Santo Domingo, Ekman 1319.3, US). F. *A. brandegei*. Mature calyx with reflexed, broad sepals, inflated top of pericarp (Sonora, México, Brandegee s.n.-Type, UC). G. *A. tamaulipensis*. Note spatulate, erect sepals, inflated pericarp top (Cameron Co., Runyon 2170, F). H. *A. × tucsonensis*. Mature calyx and pericarp top (Pima Co., Ariz., Van Devender 88-876, ARIZ). White bar in A = 1 mm holds for all figs.

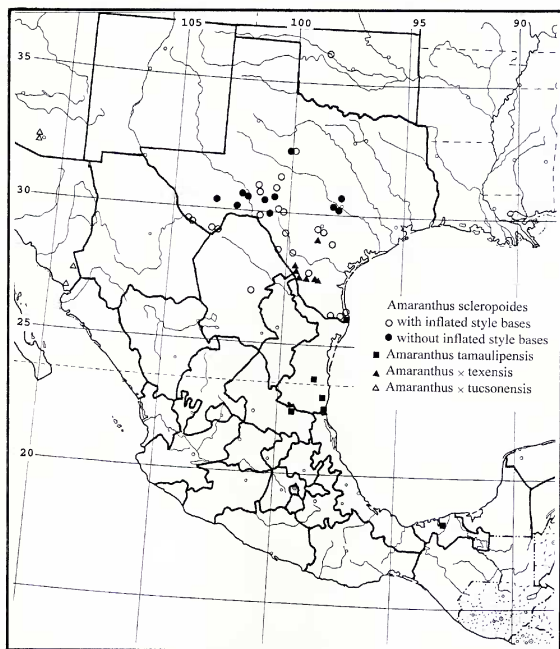


FIG. 5. Distribution of *Amaranthus scleropoides*, *A. tamaulipensis*, *A. x texensis*, *A. x tucsonensis* in southwestern U.S.A. and México.

clawed, 1.5–2.1 mm long, to 0.3–0.6 mm wide below the acute tips, spongy, thickened and all conjoined at the base, the distal portion expanded, strongly spreading, becoming nearly horizontal below the spinose tip, the base and claws stramineous, sometimes ciliate with slender gland-tipped hairs, the expanded tips with an elongate green patch 0.9–1.3 mm long, with narrow scarious margins. Fruiting ovary vertical, the wall initially smooth and with a medial encircling line, but in age becoming thickened, bullate-tuberculate in the upper half, remaining smooth below but indehiscent, the

styles 3(-2), joined into a vertical neck for 0.2-0.5 mm before the tapered styles gradually arch outward, when styles 3, with two styles larger than the third, the styles papillate along their the inner surfaces.

The new nothospecies occurs with *A. crassipes* in Webb Co., Texas and some collections (i.e., *McCart* 8559) are mixed with that species. *Amaranthus* × *texensis* is similar to *A. scleropoides* in most features, but stands apart in the distinctive narrow neck produced by the combined style bases (Fig. 4D) and by the thickened utricle wall—in these characteristics it relates to *A. crassipes*. The strongly reflexed sepals, are overall of similar structure to those found in some specimens of *A. scleropoides*, but are much thicker, as in *A. crassipes*. The pistillate sepals of *A. crassipes* are erect and may or may not be reflexed at the tip.

Additional collections: U.S.A. TEXAS. Atascosa Co.: State Hwy. 140, 4 mi W of Charlotte, 3 Nov 1962, *McCart et al.* 8538 (TEX). Duval Co.: Texas Hwy. 359, 6.5 mi E of Bruni, 4 Nov 1962, *McCart et al.* 8559 (TEX, LL—mixed with *A. crassipes* var. *crassipes*). Hidalgo Co.: McAllen Ranch, 26 Jul 1951, *Tharp, Follansbee & Thompson* 51-1628 (TEX). Webb Co.: State Hwy. 359, 1 mi E of Aguilares, 4 Nov 1962, *McCart et al.* 8595 (LL); Farm Road 1472, 10 mi NW of Laredo, 23 Nov 1962, *Solis* 93 (TEX). MEXICO. Tamaulipas: 34 mi S of Maramoros on road to San Fernando, 14 Sep 1960, *Johnston & Crutchfield* 5488C (TEX).

#### AMARANTHUS POLYGONOIDES VS. AMARANTHUS BERLANDIERI

*Amaranthus polygonoides* L. and *A. berlandieri* (Moq.) Uline & Bray are similar species readily distinguished from other *Amaranthus* by a number of features (Fig. 6). In both the flowers are borne in tight axillary dichasial clusters at each node that become distinctly crowded at the uppermost nodes. The peduncles are not thickened at maturity. The pistillate sepals are thin and distinctly three veined in the claw area, with the central vein extending into the expanded, obtuse-acute, spreading blade area. The sepals are united at the base and this basal area expands via cell enlargement to form a spongy, somewhat indurated floration device. The fruit wall is thin, cylindrical, inflated, dehiscent or not, and is topped by three expanded style bases that are exerted above the spreading sepals.

Uline and Bray (1895), Standley (1917), Correll and Johnston (1970) and others have recognized both *A. polygonoides* and *A. berlandieri* as distinct species, basically repeating the characteristics given Uline and Bray (1895) and modified by Standley (1917) in his key as noted below:

Utricle circumsissile; leaf blades suborbicular to ovate or oval, the leaves not crowded; West Indies, Florida, Texas, Mexico, northern South America.

..... *A. polygonoides*  
Utricle indehiscent; leaf blades oblong-lanceolate, the leaves crowded at the ends of the branches; central-west Texas. .... *A. berlandieri*

Moquin-Tandon (1849), in his treatment of the "Amarantaceae" (sic) in DeCandolle's *Prodrromus*, recognized the above two species in distinct gen-



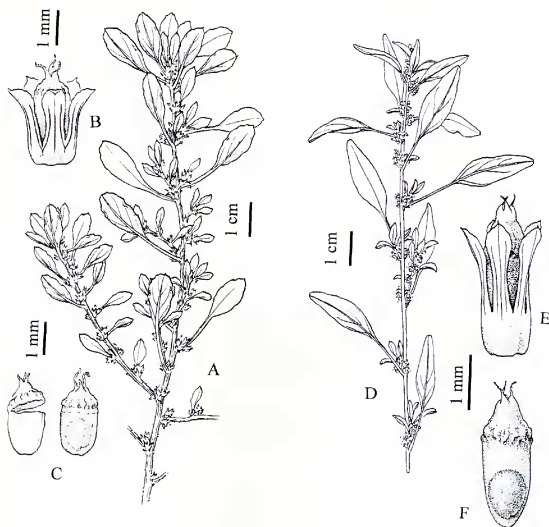


FIG. 6. Variation in *A. polygonoides*. A-C. Typical Caribbean specimen showing obovate leaf blades. B. Mature fruit with subtending calyx, note 3-veined sepals. C. Mature inflated, dehiscent fruit (all Monterrey, México, *Smith M375*, TEX). D-F. Typical Texas specimen showing more lanceolate leaf blades. E. Mature fruit with subtending calyx, note 3-veined sepals. F. Mature inflated, non-circumscissile fruit. (all Cameron Co., Tex., *Correll & Johnston 17935*, LL). Magnifications as indicated.

era in separate subtribes of his tribe Achyranthaeae. He recognized taxon *polygonoides* in subtribe Aerveae, (with indehiscent utricle) as *Amblogyna polygonoides* Raf. (monoecious, staminate flowers with 3 sepals, 3 stamens, the pistillate calyx being subglobose-funnelform, 5-parted, and the inflorescence axis not becoming thickened as in *A. crassipes*). Moquin-Tandon's newly described taxon *berlandieri* was placed in subtribe Amaranteae (with utricle circumscissile) as a new genus *Sarratia* next to *Amarantus* (sic), differing in having staminate flowers with 5 sepals and pistillate calyces funnelform-urceolate. In his description he noted *Sarratia berlandieri* had 5 anthers per male flower and circumscissile utricles.

Moquin-Tandon made several errors in characterizing these taxa. In both taxa, staminate flowers have 5 (rarely 4) sepals and both taxa have only 2 anthers per staminate flower. My observations showed that, contrary to his data, the fruit of specimens referable to *A. berlandieri* are indehiscent (not dehiscent as he stated) while those of taxon *polygonoides* are usually, but not consistently dehiscent (not indehiscent as noted by Moquin-Tandon). These errors were caught by Gray (1861, p. 168) who, in expanding the genus *Amblygne* to include two species previously placed in *Sarratia*, included taxon *berlandieri* within his *Amblygne polygonoides* noting that the specimens upon which taxon *berlandieri* was founded were very poor. In contrast, both Uline and Bray (1895) and Standley (1917) recognized both taxa within the genus *Amaranthus*. Thellung (1914), in contrast, treated *berlandieri* as a subspecies of *A. polygonoides*.

During an initial study of these taxa it was noted that the characters in Standley's 1917 key did not work consistently and several specimens showed characteristics of both taxa. Regarding fruit dehiscence, an analysis of 118 collections from F, GH, NY, TEX-LL, and US revealed the following. Specimens attributable to *Amaranthus berlandieri* are mostly indehiscent (Fig. 6F), but occasional specimens (2 of the 42 collections examined) did show a distinct encircling line below the rugate cap of the utricle. In the 76 collections of *A. polygonoides* with mature fruit examined, 36 were noted to be actually circumscissile (Fig. 6D) or at least had developed a colored line encircling the fruit wall below the tuberculate cap (however, the fruits may or may not dehisce along this line) and 35 (49 percent) were clearly indehiscent. Indehiscent utricles occur in collections from coastal Texas, Cuba, and throughout the Caribbean region, often in localities where other collections clearly have circumscissile fruits. In all instances care was taken to insure that the fruit walls were mature when the dehiscence character was scored.

As noted in Standley's key, there are some recognizable differences in leaf shape. Most specimens from the Caribbean region to coastal Texas have ovate to broadly ovate, rarely obovate (Fig. 6A), slightly more greenish leaf blades and many specimens from interior Texas and Mexico have more narrowly trullate or trullate-lanceolate (Fig. 6D), somewhat bluish-gray leaf blades. To illustrate this a series of leaf-blade length-width ratios were taken. The ratios of specimens from the Caribbean and coastal Texas attributable to *A. polygonoides* range from 1.3 to 2.6 times longer than wide. Those of inland areas attributable to *A. berlandieri* have leaf-blade length-width ratios ranging from 2.1 to 4.2 times longer than wide. The problem is that when plants are mapped out based on these leaf characteristics we find several collections from Sutton, Edwards, Tom Greene, Terrell, Presidio and Pecos counties in Texas, as well as collections from Coahuila, that clearly have broad leaves

as in taxon *polygonoides*. In many cases nearby specimens have narrow leaves as in taxon *berlandieri*. Recognition of two taxa on the basis of this characteristic would be quite arbitrary. Likewise leaves and inflorescences are crowded at the distal stems in both taxa and the taxa could not be separated on the basis of this characteristic. In fast growing stems, the leaves in both taxa are well separated by long internodes.

As the distinguishing characteristics of these taxa are very weak and variable, the two taxa are combined into a single variable species with recognition that there are some trends present, but they are insufficient for nomenclatural recognition. Thus only one species is recognized from this complex as follows.

***Amaranthus polygonoides* L. (Figs. 4E, 6, 7), Pl. jamiac. pug. 2:27. 1759.**

*Roemeria polygonoides* (L.) Moench. Meth. 314. 1794; *Amblogyna polygonoides* (L.) Raf., Fl. Tell. 3:42. 1837; *Albersia polygonoides* (L.) Kunth, Fl. Berol. ed. 2, 2:144. 1838. *Sarratia polygonoides* Moq. in DC. Prod. 13(2):270. 1849, as synonym. TYPE: JAMAIACA: Linnaeus' 1759 protologue referenced "Sloan. jam. 1. t. 92. f2." (H. Sloane's *Voy. Madera Jamaica* 1:144 tab. 92, fig. 2. 1707) where the taxon was designated by a polynomial "*Blitum polygonoides virde, seu ex veridi & albo variegatum, polyanthos*". Linnaeus only saw Sloane's figure and not the specimen from which it was drawn, hence the specimen (Herb. Sloane 2:116, BM), can not be designated as lectotype. I herein designate the illustration in *Voy. Madera Jamaica* t. 92, fig. 2, as lectotype. The original Sloane plate 92, and the Sloane specimen, from which it was drawn, are at BM (C. Jarvis, pers. comm.). Sloane (l.c.) notes: "It grows in hard Clay grounds, and amongst Rubbish, every where about the Town of St. Fago de la Vega." St. Fago de la Vega is now known as Spanish Town. Elizabeth A. Kellogg, *Fl. Lesser Ant.* 4:160. 1988, treated the Sloane specimen as "Type," however, for reasons noted above, it may not serve as lectotype.

*Amaranthus verticillatus* Pavon, Moq. in DC. Prod. 13(2):270. 1849, as synonym.

*Sarratia berlandieri* Moq. in DC., Prod. 13(2):268. 1849; *Amaranthus berlandieri* (Moq.) Uline & Bray, Bot. Gaz. 19:268. 1894. *Amaranthus polygonoides* subsp. *berlandieri* (Moq.) Thell. in Ascherson & Graebener, Syn. mitteleur. Fl. 5(1):352. 1914. TYPE: MÉXICO. Inter S. Fernando et Maramoros, *Berlandier* 2279 (HOLOTYPE: G-DC not seen; ISOTYPE: GH!).

Low spreading to erect-ascending, monoecious annuals 2–4 dm tall; stems branched below, the lateral (or all) branches decumbent, sometimes ascending, 1–4 dm long; internodes 2–5 cm long below, reduced to 2–5 mm long distally, stramineous, striate, puberulent-villous with crisped moniliform hairs 0.2–0.5 mm long, the lower stems glabrate. Leaves alternate, ascending, often crowded, larger in the upper half of the plant; petioles (2–)5–20(–40) mm long; leaf blades ovate to trullate-lanceolate, sometimes obovate or lanceolate, (4–)8–25(–42) mm long, (2.4–)5–15(–23) mm wide, rounded, obtuse or emarginate with the midvein excurrent at the tips, narrowly to broadly cuneate at the base, glabrous, the margins entire to erose, the veins and margins whitish beneath, the lamina with distinct Kranz internal anatomy, green

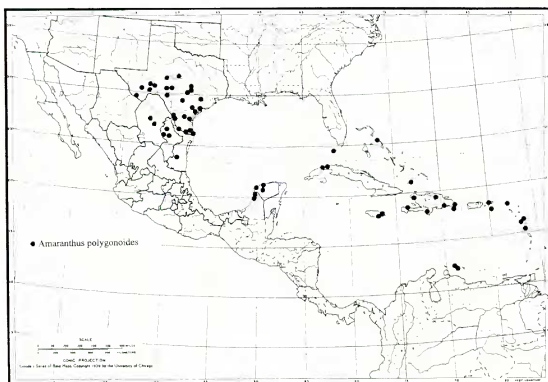


FIG. 7. Distribution of *Amaranthus polygonoides*.

to grayish in color. Flowers borne in axillary congested globose dichasia 3–8 mm in diameter, these remote on the lower branches but becoming aggregated as the internodes shorten above, the inflorescence axes thin, to 2 mm long; bracts and paired bracteoles lanceolate, 1–1.5 mm long, membranous, curved and cupped below, attenuate often with a long excurrent midvein at the tip; staminate flowers: sepals (4–)5,  $\pm$  unequal, 0.7–1.3 mm long, membranous except for the midvein; stamens 2, anthers 0.4–0.6 mm long, filaments moderately thickened, to 1 mm long; pistillate flowers: mature calyx (1.6–)2.3–3.0 mm long, the sepals united and becoming spongy-thickened in the lower third forming an expanded float 0.9–1.2 mm long and wide that slightly extends over the subtending broad-tipped pedicel, the separate lobes clawed, spatulate, the claws 0.3–0.4 mm wide, notably 3-nerved, with scattered slender gland-tipped hairs, the lobes to 0.6–1.2 mm wide, erect to recurved-spreading, rounded to acute at the tips with the midvein sometimes excurrent, membranous except for the 3 veins, the lateral veins straight, slightly spreading outward, diminishing below the margin, the midvein strongest, unbranched, when young overlain with a narrowly oblanceolate central green patch. Mature ovary wall (the utricle) inflated, adnate to the spongy calyx in the lower third, the mid portion smooth, compressed, 0.7–0.9 mm long and wide, sometimes developing a darker encircling line just below the expanded tip (where dehiscence may occur), the distal tip

portion variously roughened, sometimes distinctly expanded at the base, capped with the narrower, fused, obconate, expanded style bases 0.4–0.6 mm long and wide, the styles 3(–2), the papillate slender terminal portions 0.5 mm long. Seed vertical, lenticular, 0.8–0.9 mm long,  $\pm$  0.7 mm wide, 0.35–0.5 mm thick, reddish-brown, smooth, shiny, the margins thin.

The species ranges throughout the Caribbean region to coastal Central America, Key West Florida to central and western Texas and adjacent Mexico (Fig. 7) occurring mostly in disturbed habitats. Also cultivated in Germany, Italy and Egypt (Thellung 1914). Collections from Sonora and Sinaloa with more erect, slender habits and similar staminate and pistillate flowers but with the central vein of the pistillate sepals conspicuously branching are referable to *Amaranthus venulosus* S. Wats.

#### A NEW *AMARANTHUS* FROM EASTERN MEXICO AND SOUTHMOST TEXAS

During initial observations of Mexican *Amaranthus*, a series of collections distinguished by inflated turret-like style bases and short, slender, basally connate, erect, well-separated, spatulate sepals, and bracts much shorter than the sepals were marked as possibly new. In Standley (1917), the taxon keyed closest to *A. brandegei* Standl., a species known only from a few collections in eastern Mexico (the type collection is from Sinaloa, México), with which it shared the characters of 3 stamens per male flower and short pistillate floral bracts. A loan of the type collection of *A. brandegei* from UC confirmed that our material is indeed similar to *A. brandegei*, but *A. brandegei* actually has 5(–4) stamens per male flower, as previously noted by Sauer (1950), not 2–3 as stated by Standley (1917). In its small perianth and short bracts the new species also showed similarities with *A. dubius* Mart. ex Thell., which also has 5 stamens per staminate flower.

*Amaranthus dubius* is a tropical, sometimes temperate, New World weedy species common from the Caribbean region, southern Mexico to Panama and northern South America. It is adventive in Africa and tropical Asia and cultivated in Europe (Aellen 1959), Jamaica (Correll and Correll 1982), and elsewhere. It has been reported as one of the very few polyploid ( $2n=64$ ) species in the genus (Grant 1959). Floral differences between *A. brandegei* and *A. dubius* are illustrated in Sauer (1950); pistillate flowers of *A. dubius* are illustrated in Aellen (1959), and both taxa are described in Standley (1917). In the material seen, both *A. brandegei* and *A. dubius* are more robust plants with larger, leaves to 12 cm long and 8 cm wide with distinct terminal inflorescences. I have seen additional material of *A. brandegei* from Tom Van Devender's recent collections from Sonora and Sinaloa, México, which have larger leaves than the type.

In *A. brandegei* the larger pistillate sepals are reflexed, thickened at the

base at maturity and the midveins often branch distally, the fruit wall is smooth below the line of dehiscence but roughened above the line (Fig. 4F). In contrast in *A. dubius*, all pistillate sepals are erect, they do not thicken at the base at maturity and have distinct single green midveins bordered with thin membranous margins and the fruit walls are typically elliptical and often smooth throughout. In the new taxon (Figs. 4G, 8) the sepals are much thicker, the margins are often not membranous medially, the sepals are distinctly thickened and join together at the base of the developing fruit and are typically shorter than the developing fruit. They are somewhat contracted in the lower half and slightly broader below the acute to obtuse-rounded tips. The sepals are often green along the distal midvein and in the larger, marginal sepals, the midveins are branched distally. The fruit wall is irregularly rugose throughout and has a distinct smooth tower. Furthermore the plants are much more slender, with small leaves that continue, though diminished in size, well into the inflorescences—they do not develop distinct leafless terminal inflorescences as in the other two species. Also the new taxon has only three stamens per male flower not 4–5 as in the other species.

***Amaranthus tamaulipensis*** Henrickson, sp. nov. (Figs. 4G, 5, 8). TYPE: MEXICO. TAMAULIPAS: 13 mi N of Aldama on road to Soto la Marina, 25 Sep 1960, M.C. Johnston & J. Crutchfield 5698 (HOLOTYPE: TEX!).

*A. Amarantho brandegei-dubius* differt calyce pistillato sepalis binis ad margines ovarii quam tribus altera majoribus (vs. sepalis abaxiali maxima), sepalis erectis (non distaliter reflexis ad maturitatem), et pericarpio maturo omnino inflati-tuberculato (vs. distaliter inflati-tuberculato).

Erect to ascending, sometimes decumbent monoecious annuals 1.5–3(–6) dm tall; stems branched at base, sparsely branched above or unbranched, striate, glabrous, slender, tan-stramineous or suffused with betalin red, 1–3.2 mm thick at base. Leaves largest near the base, reduced above, the petioles 3–15(–21) mm long, one-half (when small) to as long as the leaf-blades; leaf blades ovate, rhombic-ovate, (5–)10–27 mm long, (2–)5–11(–18) mm wide, tapering to an obtuse-rounded, typically emarginate tip topped with the excurrent midvein, the base cuneate, decurrent along the petiole, the margins rather crisped, white, the blades green above, gray-green with 3–4 arcuate white, raised veins beneath. Flowers in glomerate axillary dichasia from base of plant to the tip, either interrupted at the nodes, or crowded or interrupted in terminal leafy spike-like inflorescences, the 2 lateral branches of the dichasium unbranched, zig-zagged, to 4 mm long; bracts lance-ovate, acute, conduplicate-cupped, green along midvein, otherwise scarious-membranous, 0.9–1.2(–1.4) mm long, shorter than the sepals, persisting on inflorescence axis where 0.4–0.8 mm apart; bracteoles 2, similar to the bracts but 0.3–0.8 mm long, often membranous throughout, persistent or not;

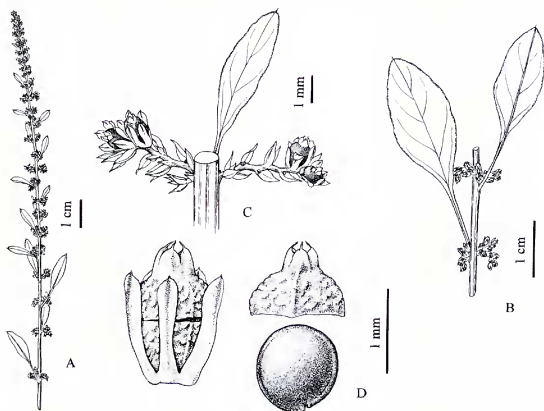


FIG. 8. *Amaranthus tamaulipensis*. A. Terminal stem. B. Older stem showing inflorescence development and leaves. C. Axillary inflorescence with most fruits gone showing persistent bracts, single leaf. D. Mature tuberculate, dehiscent pericarp with calyx; note inflated style bases, separate pericarp tip, seed. All from holotype (Aldama, Tamaulipas, Mex., Johnston & Crutchfield 5698, TEX, except C from Cameron Co., Tex., Ranyon 2170, TEX). Magnifications as indicated.

staminate flowers: basal and scattered on the lateral dichasial shoots, sepals 4–5, oblong-ovate, acute-acuminate, 1.2–1.6 mm long, green along the excurrent midvein, otherwise scarios; stamens 3(–4); pistillate flowers: sepals 5, separate and not overlapping except where expanded and joined at the base, oblong-spatulate, subequal with the two marginal sepals usually larger (broader) than the other three, 1.1–1.6(–2.1) mm long, narrowed to 0.2–0.3(–4) mm wide in mid portion, expanded, obtuse-rounded, to 0.25–0.6 mm wide near the tip, rather scarios except along midvein, becoming gibbously thickened, spongy and joined around ovary at base, the smaller 3 sepals 1-veined and green along the vein above, the largest 2 sepals with the midvein green and weakly branching distally (in some specimens the veins in all sepals branching distally and the tips rounded to acute), the calyx shorter than the mature fruit, the sepal margins typically sparsely glandular-puberulent. Mature utricle obpyramidal, slightly biconvex, 1.5–1.7 mm long, to 1.1 mm wide, with age becoming brownish, rugose tuberculate throughout the

body with ridge-like branched folds, medially circumscissile but no specific line of dehiscence evident, the utricle tipped by a distinct, lighter tan, smooth, rather inflated, dome-like style base 0.3–0.5 mm long, 0.5–0.6 mm wide, with 3 broadly conic lobes at tip each bearing a papillate stigmatic line along the inner margin that extends onto a slender 0.2–0.3 mm long tip. Seeds black to reddish-brown, smooth, shiny, lenticular, orbicular, 1.0–1.2 mm wide, 0.6 mm thick, margins edged, slightly notched at base.

Additional collections: U.S.A. TEXAS. Cameron Co.: 2 mi S San Benito, 4 Jul 1939, *Ranyn* 2170 (TEX); E of Brownsville, 28 Oct 1927, *Rose & Russell* 24274 (US). MEXICO. San Luis Potosí: Vicinity of El Salto above El Naranjo, 6 Apr 1960, *Duke* M3760 (NY). Tabasco: Arrozal experimental del Depto. de Agronomía, Colegio Superior de Agricultura Tropical, km 22 carretera Cárdenas-Coatzacoalcos, 14 Apr 1980, *Couan* 2913 (NY). Tamaulipas: 2 mi NE of Altamira, roadside weed, 3 Mar 1961, *King* 4056 (F, NY, TEX, US—a more decumbent plant with slender stems); 2 mi E of Casas on new Victoria-Soto la Marina Hwy., 28 Sep 1960, *Johnston & Crutchfield* 5770 (TEX).

As noted above, the species structurally is similar to *A. brandegei* and *A. dubius* but is immediately distinguished from *A. brandegei* by its erect, not reflexed calyx and from *A. dubius* by: 1) the narrow subequal, well-separated, firm (not membranous margined) spatulate, acute to round-tipped pistillate sepals that are shorter than the fruit and are expanded and united at the base; 2) the distinctive roughened (not smooth) utricle wall with its smooth, inflated, turban-like style bases; and 3); the 3 stamens. The sepals along the edges of the compressed fruit are usually largest and typically have veins branched below the tip. In *A. dubius* the bracts and pistillate sepals are larger, more elliptical, more membranous, stamens number 5(–4) in male flowers and the utricle wall more gradually expanded above. *Amaranthus dubius*, however, exhibits variability in bract length, sepal size, mature pericarp configuration and may be confused with unarmed individuals of *A. spinosus* L. with which it hybridizes (Grant 1959). Three varieties were described by Moquin-Tandon (1848) under *A. tristis* L. and transferred to *A. dubius* by Thellung (1914) (see Thellung 1914; Aellen 1959), but these are seldom accepted. They involve differences in inflorescence development, color and thickness.

#### A NEW TAXON FROM ARIZONA

Dr. Tom Van Devender requested identification of a series of *Amaranthus* collections from the Tucson Mountains and Organ Pipe National Monument west of Tucson, Arizona. The collections show a number of characteristics unlike any other southwestern *Amaranthus*. In Standley's (1917) key, the material, which has non-spatulate pistillate sepals, dehiscent utricles, a terminal inflorescence, no spines, bracts shorter or equal to the pistillate sepals, and the fruit shorter than the sepals, keys to the aforementioned *Amaranthus*



*dubius*, a species with much shorter sepals, smaller seeds, etc. The Arizona specimens are small, erect, branched, monoecious annuals with coarse ovate leaves with dichasial cymes extending from the mid-leaf axils into a leafless terminal inflorescence. Staminate flowers have 5 sepals and 5 anthers; pistillate flowers have broad-based, acuminate bracts shorter than or about as long as the pistillate sepals (Fig. 9). The pistillate sepals are oblong, slightly spatulate, but not clawed; the outer sepals are usually acute, somewhat spine tipped, the inner ones are more obtuse or rounded. The sepals are distinctive in being green throughout most of the surface except for the moderately narrow scarious margins. As the sepals mature and dry, they reflex and become thick and rigid. The fruit is dehiscent, about as long as the sepals, with 3-2 styles, and is inflated and roughened above the line of dehiscence (Fig. 9C).

While this appears to be an unremarkable assortment of characters, the plants do not fall into any recognized taxon. Evidence of its possible relationship came from a specimen from Chiapas [32 km. N. Ocozocoautla along rd. to Mal Paso, 19 Oct 1965, *Breedlove & Raven 13572* (LL)] annotated by J.D. Sauer as *Amaranthus hybridus* L.—atypical. This specimen has an inflorescence arrangement characteristic of *A. hybridus*, but the pistillate flowers have small bracts and indurated sepals longer than the utricles—very similar to the Arizonan specimens. However, the Arizonan specimens differ in having axillary dichasia and terminate in a single spike of dichasia, an inflorescence type more characteristic of *Amaranthus* species with clawed spatulate pistillate flower sepals, e.g. *A. obcordatus* (Gray) Standley, *A. chihuahuensis* S.Wats, *A. torreyi* (Gray) S.Wats. Somewhat similar plants have been found near Alamos in southern Sonora, México. They are similar in development of the pistillate sepals, but in each the bracts are as long as or longer than the sepals and one collection, more reflexed. *Amaranthus hybridus* differs from the new taxon in the overall structure of the inflorescence, it produces a tight series of slender, ascending-spreading shoots, the slender, longer bracts that well exceed the flowers, and the membranous pistillate sepals that are typically green only along the midvein.

A question arises as to the origin of this taxon. Is it just an obscure taxon that has not been previously collected or is it a taxon of recent origin, perhaps a product of hybridization? A brief analysis of pollen stainability of the specimens revealed that pollen in Arizonan specimens varied greatly in stainability with Cotton-Blue in Lactophenol (Radford et al. 1974), with one collection having 99 percent stainability and other collections having 96, 89, 81, 51, and 47 percent stainability. The two collections from Sonora, both had high pollen stainability (97 and 95 percent). My conclusion is that the taxon may be of hybrid origin, perhaps with *A. hybridus* being one

parent, the other parent unknown. The only other species known from the Tucson Mountains are *A. fimbriatus* (Torr.) Benth. and *A. palmeri* S.Wats. (Rondeau et al. 1996), which are not parental candidates based on their characteristics.

The Sonoran specimens both differ from the Arizona specimens. In *Van Devender* 93-386 the pistillate sepals show green mostly along distinct secondary veins and subtending bracts have straight, long slender tips and a membranous ovate base. The other specimen (*Van Devender* 92-1121) has greenish sepals similar to the Arizonan specimens, but the subtending bracts are as long as the sepals, strongly reflexed below the tip, and are sharp pointed.

***Amaranthus* × *tucsonensis* Henrickson, nothosp. nov. (Figs. 5, 9).** TYPE: U.S.A. ARIZONA: PIMA CO.: Tucson Mts., crest of Gates Pass, W of Tucson, T14S, R12E, S10, SW 1/4, 3250 ft, 16 Sep 1988, T.R. Van Devender 88-676 (HOLOTYPE: ARIZ; ISOTYPES: to be distributed).

*Amarantho hybridus* differt sepalis multo majoribus firmioribus viridibus scariosi-marginatis (non omnino tenuis scariosus), bracteis floralibus pistillatis sepalis pistillatis aequantibus vel brevioribus (non 1.5–2.0 plo longioribus), axe inflorescentia vestimento sparsio trichomatorum glandulosi-capitatorum (non dense villosus eglanduloso) et seminibus 1.2–1.4 mm in diametro (non 1.0 mm in diametro).

Erect, taprooted, mostly single-stemmed or upwardly branched monoecious annuals to 1.5 dm tall; stems yellowish, sometimes tinged with red, striate, sparsely puberulent-pilose with crinkled, obscurely gland-tipped moniliform hairs to 0.3(–0.6) mm long, glabrate. Leaves alternate; petioles yellowish, 8–32 mm long; leaf blades rhombic to ovate, (13–)20–35(–45) mm long, (7–)10–22(–28) mm wide, obtuse to rounded, often mucronate at the tip, broadly cuneate with the margins narrowly decurrent along the distal petiole at the base, the margins crisped, the lamina grayish-green, glabrous to sparsely puberulent-pilose with crinkled, gland-tipped hairs to 0.3 mm long, the veins yellowish, impressed above, raised beneath. Flowers borne in axillary, compound dichasial cymes to 10 mm long, these forming discontinuous glomerules below, but coalescing into terminal, continuous inflorescences 6–15 cm long, 8–10(–16) mm wide, the basal (oldest) flower(s) staminate, developing lateral, sinuous, occasionally branching axes to 1 mm thick, covered with the persistent bracts and bracteoles that subtended the early deciduous male flowers. Staminate flowers: bracts broadly ovate at base, acuminate above with the midvein excurrent, 1.7–2.5 mm long, scarios except along the green midrib; sepals oblong-elliptical to lanceolate, 1.6–2.2 mm long, 0.6–1.0 mm wide, acute-acuminate, scarios except along the short excurrent midrib; stamens 5; filaments 1–1.8 mm long; anthers 0.8–1.0 mm long, yellow. Pistillate flowers: bracts lanceolate to basally ovate, 1.5–3.5 mm long, 0.8–1.4 mm wide, usually shorter than the sepals, broadly scarios below, the green midrib zone 0.2–0.5 mm wide, the midvein ex-

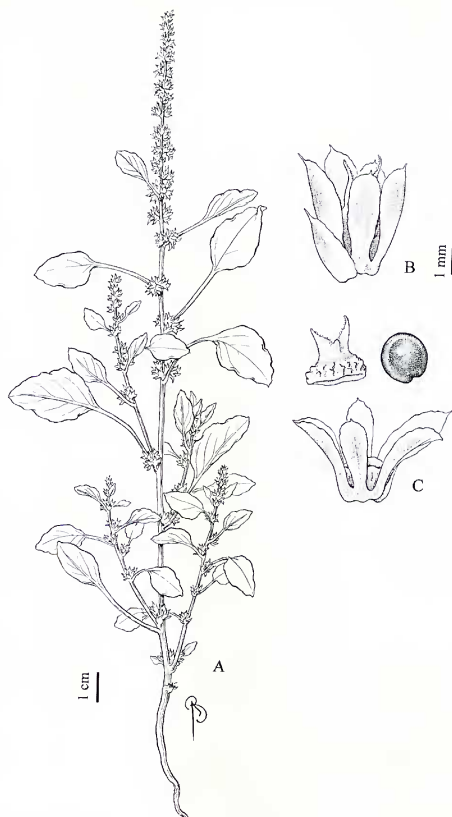


FIG. 9. *Amaranthus*  $\times$  *tucsonensis*. A. Growth habit. B. Mature calyx showing short subtending bract. C. Calyx and base of pericarp, tip of pericarp and seed. All from holotype (Pima Co., Ariz. Van Devender 88-676, ARIZ). Magnifications as indicated.

current for 0.5–0.6 mm, bracteoles 2, similar but only 1.4–2.2 mm long; sepals 5, oblong, oblong-spatulate to oblong-elliptical, 2.2–3.1(–4) mm long, 0.6–1.2 mm wide, obtuse, rounded to emarginate, the outer ones more acuminate with the midvein excurrent 0.1–0.3 mm at the tip, entire to erose distally, green for 0.5–0.9 mm across the back, with scarious margins 0.15–0.2 mm wide, glabrous to sparsely puberulent-pilose with crinkled, obscurely gland-tipped hairs, unequal in size with the outermost sepal larger and more acute than the inner round-tipped sepals, at maturity all sepals strongly reflexing, thickening and uniting at the base and overall becoming indurate. Fruit 2.2–2.5 mm long, circumscissile, the base smooth, the top roughened, inflated above the zone of dehiscence, the 3 style bases with a U-shaped sinus; stigmatic surfaces 1.2–1.3 mm long, puberulent with moniliform hairs. Seeds broadly lenticular, slightly ovate, 1.2–1.4 mm wide, shiny black, with a slight marginal rim.

Additional collections. U.S.A. ARIZONA. Pima Co.: Javelina Wash, Saguaro National Monument, Tucson Mts., T13S,R11E,S35,NE 1/4, 2680 ft, 4 Sep 1989, *Bertelson 89-555* (ARIZ); Tucson Mts., crest of Gates Pass, T14S,R12E,S10,SW1/4, 3250 ft, 23 Sep 1988, *Van Devender 88-722* (ARIZ); Tucson Mts., crest near Radio Towers, NW of Trail's End Canyon, T14S,R12E,S4,NW 1/4, 4350 ft, 18 Sep 1988, *Van Devender et al. 88-693* (ARIZ).

MEXICO. Sonora. Rancho La Junta, 3.0 km NNE of Burapaco, 27°35'15"N, 108°52'W, 220 m, 17 Mar 1993, *Van Devender et al. 93-386* (ARIZ); Mesa Masiaca, 6.5 km WNW of San José de Masiaca, 26°46.4'N, 109°17.9'W, 200 m, 8 Oct 1992, *Van Devender et al. 92-1121* (ARIZ).

In the Tucson Mountains, west of Tucson, Arizona, the taxon occurs on rocky slopes in desert scrub and grassland from 790–1430 m elevation (Rondeau et al. 1996). In northern Sonora it is known from elevations about 200 m in fields and roadsides. Flowering occurs from September to November or after rains.

#### ACKNOWLEDGMENTS

I thank F, GH, NY, TEX-LL, UC, US for loan of specimens, Charles Jarvis (BM) for information regarding the type of *A. polygonoides*, U. Braun (HAL) for information on the type of *A. crassipes*, Bobbi Angel (NY) for the line drawings, Thomas Wendt for comments on the manuscript and the Spanish translation of the abstract, Guy Nesom for the Latin translations, and the Plant Resources Center at the University of Texas, Austin for use of facilities.

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## INDEX TO SCIENTIFIC NAMES

<b>Amaranthus</b>	palmeri	<b>Blitum</b>
albus	polygnoioides	polygonoides
berlandieri	scleropoides	<b>Euxolus</b>
brandegei	tamaulepensis	crassipes
chihuahuensis	× texensis	<b>Roemeria</b>
crassipes	torryi	polygonoides
var. crassipes	× tucsonensis	<b>Sarratia</b>
var. warnockii	venulosus	polygonoides
dubius	verticillatus	<b>Scleropus</b>
fimbriatus	warnockii	amaranthoides
graecizans	<b>Amarantus</b>	crassipes
hybridus	<b>Amblogyne</b>	
obcordatus	polygonoides	